

## **Accelerator Systems Division Highlights for the Week Ending June 28, 2002**

### **ASD/LBNL: Front End Systems**

The first four shipments with Front-End equipment have all safely arrived at Oak Ridge. The fifth shipment includes the High-Voltage Enclosure for ion-source and LEBT ancillary systems ("Big Blue Box"), MEBT racks, wire ways, and cable trays. It left Berkeley on June 26 and is scheduled to arrive at Oak Ridge on Monday, July 1.

Preparations to assemble the last shipment are currently underway.

Work on final documentation for electrical systems is continuing.

### **ASD/LANL: Warm Linac**

The second 805-MHz transmitter passed the factory test at Titan and is being prepared for shipment to ORNL. (WBS 1.4.1.1)

The third 402.5 MHz Marconi klystron was delivered and has been installed. This tube passed the full power, full efficiency specifications. (WBS 1.4.1.1)

The fifth 402.5 MHz transmitter started tests at Titan. (WBS 1.4.1.1)

The prototype high-voltage converter modulator (HVCN) was pulled from the oil to perform an inspection after the Marconi klystron heat run, the 805 MHz window test, and the 805 MHz load test. No oil tank problems were found. We did find blown fuses on the IGBT Bias Boards, and are examining the cause. Operations did not seem to be affected by the bias board problem. The modulator was back under oil 6/27. (WBS 1.4.1.2)

While we had the prototype HVCN out of the oil, we took the opportunity to upgrade a few items to the current design, including latest voltage divider design put into oil tank after calibration. We want to see if nearby metallic structures in the tank change the calibration. The de-q resistor was replaced with a new high power design. (WBS 1.4.1.2)

The first new copper IGBT switch plate was received (1 of 4). The copper design is needed for full power (10 MW peak) operation. (WBS 1.4.1.2)

Utility grid modeling shows a possible problem with ORNL AC distribution network. The modeling effort needs further input from ORNL. A meeting has tentatively been scheduled for the week of July 15. (WBS 1.4.1.2)

Additional Mitsubishi IGBT's were received. (WBS 1.4.1.2)

We modified our approach on revisions to the LLRF FRCM. The original Rev B that included many changes to the PLD code and PLD pinouts has been put on hold in order to meet near term deadlines. We've decided to make minor known modifications required of revision A and issue an interim Revision B board. We will build up four of these boards. This will allow us to speed up final development and provide the early systems, including the JLAB SRF system in August. We are also been making progress on the VXI interface. (WBS 1.4.1.3)

HPM work continued. This unit is very close to completion. Issues remain with the FLASH memory, a few of the diagnostic LEDs, and the fiber optic arc detector channels. These should be solved and completely wrapped up within the next few weeks. (WBS 1.4.1.3)

ORNL staff made final checks of the CDM Rev C. We are getting 5 boards built, and 4 will be stuffed with components. (WBS 1.4.1.3)

We started working with ZTEC on the DSP programs, taking advantage of ZTEC's many man-years of experience in this arena. ZTEC's approach will lead to maintainable, upgradeable, DSP programs, and will eliminate a lot of upgrade patches and confusing firmware that revised DSP code often becomes. (WBS 1.4.1.3)

Amy Regan was at ORNL to meet with the ASD RF team and discuss delineation of work details. Details about the racks got straightened out, and we worked out a hand-over of some preliminary DSP software information to the Global Controls Group. (WBS 1.4.1.3)

LANL visitors conducting work at ORNL this week also included Kirk Christensen and Rick Martineau who provided support for DTL Tank 3 testing, documentation, and acceptance criteria updates. (WBS 1.4.2.7)

The final machined post couplers and slug tuners for DTL Tank 3 arrived at ORNL and were installed. Initial bead pulls showed excellent field profiles, tunability, and performance. (WBS 1.4.2.7)

Scotty Jones has joined LANL SNS Division as our Operations Officer. He replaces Doug Pippin who recently retired after many years of service. (WBS 1.4.6.7)

### **ASD/JLAB: Cold Linac**

### **ASD/BNL: Ring**

Nuria Catalan-Lasheras and Yannis Papaphilippou were visitors at BNL this week critiquing our progress since last winter.

Technical and cost evaluations of the Ring dipole high field power supply continue. After a review of the technical offerings, a request for a best and final offer is being prepared for the responsive bidders. A videoconference with ASD is on the horizon.

The SNS magnet parameter list has been finalized and a copy sent to Stuart Henderson for review.

Chicane #4 (injection) arrived at BNL from New England Techni-Coil. The coil potting was observed to be of poor quality. Thus, this magnet has been rejected and will be returned to the vendor for repair.

Last week we issued an order to BNL Contracts for the turbo pump Gauge Controllers.

Type B Ring dipoles: The polarity reversing switch and bus work changes took longer than expected. We plan to resume measurements today.

26Q40 (8) quadrupole (Stangenes): long coil measurements will be completed today at BNL and the data will be reviewed to determine acceptability for a production run.

21Q40 (60) quadrupole (Stangenes): eleven are in house and six more due to be shipped this week.

Engineers and AP Group are developing a test plan for the Injection magnet and Injection PS System.

Our Diagnostics Group is working with ASD's Tom Shea on the agenda and presentations for the Diagnostics Design Review to be held by videoconference on July 23, 24 and 25.

Next week, BNL reps will travel to Varian Vacuum Products, our turbo pump vendor, to review and resolve quality related issues from the 1<sup>st</sup> article assembly.

The 1<sup>st</sup> article RTBT collimator (RTBT #2) left France for Oak Ridge last week. See attached photos.

We are still awaiting the arrival of Budker's 1<sup>st</sup> article 30Q58 quad that has been shipped to BNL for acceptance testing. As of this writing, the shipment has been traced to U.S. Customs, JFK International Airport (NY).

Last week, we received the last of the sextupole and octupole corrector magnets. Thus, all 20 units are now in house from NE Techni-Coil.

Designers are looking to install Clearing Electrodes in the collimator straight section of the Ring to help reduce electron cloud formation.



## Controls

Installation of controls equipment at the site began in earnest this week. The first servers have been installed in the Front End Communications Room – they will be powered as soon as roof repairs are completed which will permit adequate cooling. The complete back row of racks has been installed in the Temporary Control Room (see photo below). These are partially loaded.



The first DT Resonance Cooling Control System (RCCS) rack is complete and ready to go to the site. It will be delivered on Monday. A redesign was required for installation of a power panel and wireways added to this (and all RCCS racks) by ORNL. The redesign assures that the RCCS equipment will not have to be removed and reinstalled, which will shorten installation time for both the controls and AC power wiring teams. Parts for subsequent RCCS racks have been shipped from LANL, and we anticipate having all RCCS racks assembled and tested before they are needed.

Considerable effort was spent planning for the controls contribution to the upcoming cryomodule/LLRF integration test at Jefferson Lab. The controls team has a part in almost all aspects of this test – LLRF interface, heater controls, tuning (both motor and piezo) controls, timing and control room servers. Several components have been ordered for this test.

A purchase order was released for the production Machine Protection System (MPS) chassis. DCS in Knoxville is making the modified printed circuit boards and chassis. Two units are scheduled for delivery the second week of July.

A new version of the Timing System Event Encoder was received at ORNL (from (BNL) this week. Interrupt handling software is being updated to conform to design decisions made at the timing review last January.

The SNS controls team has become a major player with other members of the EPICS community in the requirements specification, design and implementation of a significant EPICS timing system software change to assure high resolution time correlation from time stamps provided from an external source (as will be the case for SNS.) Major progress on this timestamp upgrade was made this week, and these changes have been checked in to our software repository.

All Front End Control Screens have been converted to the SNS-standard EDM display manager, and the new software committed to the software repository. This conversion will be implemented only after the front end has been tested with screen as delivered.

The SNS contribution to a merged version of the Matlab EPICS Channel Access interface was submitted to SLAC this week. SLAC will add Win32 support, after which a single version will be maintained for the entire community.

At LANL work continued with EPICS support for the low-level RF system. Testing scripts have been provided, and an EPICS sequence was used to ramp the RF drive & pulse width for testing of the second klystron.

At BNL work began on the Beam Dump temperature monitoring system.

A decision was made to use only 16-bit digitizers for the BNL-designed BLM system. Experimental results show that beam loss at the 1 watt/meter level can be accurately measured without resorting to 24-bit digitizers. This decision will simplify the system design.

The CHL refrigerator needs a stable load for reliable operation. When RF to a superconducting cavity is turned on or off, the load on the refrigerator changes. Electric heaters are installed in each of the cryomodules and the power supplied to each heater is adjusted to compensate for the heat generated by the RF power. An EPICS heater control sequence has been developed. The sequence monitors several RF parameters and calculates the amount of make-up heat that is to be provided by each of the cavity electric heaters. The sequence is currently being tested with simulated data. Operation of the EPICS back-up and restore facility (BURT) was also verified during testing of the heater control sequence.

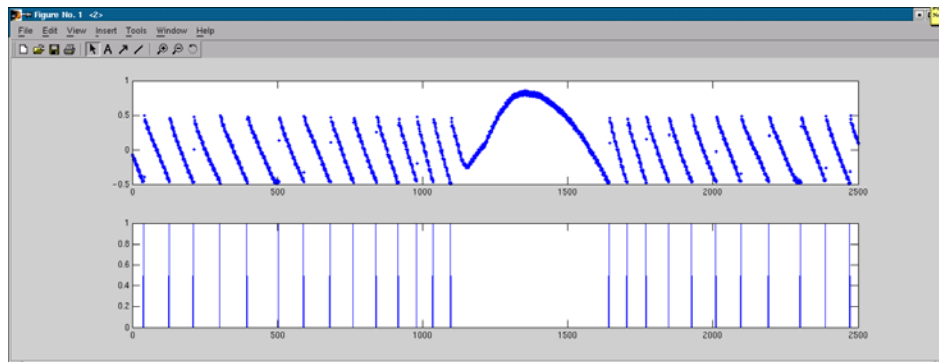
Progress was also made in the design of the wiring for the cryomodules and the CHL 4.5 K cold box PLC and IOC systems.

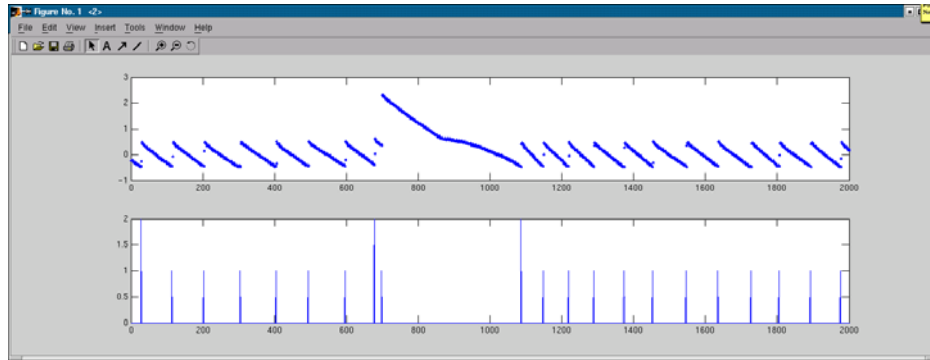
A contract for the procurement of the LVDT position sensors interface modules was awarded. These modules (V550) are used to monitor the position of the cryogenic valves that supply helium to the cryomodules. Each of the V550 modules monitors the 5 electrically actuated valves on one cryomodule. A quote was received from for the fabrication of the Central Helium Liquefier Building Control Room Racks. The 9 racks in the CHL control room house the EPICS Operator Interface Workstations, dedicated panel meters, PLC and EPICS programming workstations, and the CHL ODH hardware.

The 60% complete Title II design package for the Communications Backbone was submitted for review.

A Pre-bid meeting held with Sverdrup and Innovative Controls, and an amended solicitation was issued for a design/build proposal for phase 1 Personnel Protection System (PPS) PLC racks for the entire Linac. Three PPS procurements were released this week. The build to print specifications for the small power supply controllers and the beam shutdown stations were released for the phase 1 procurement. The functional specification for the DTL 3 tank conditioning RF control panel was also released.

An EPICS data acquisition system has been developed for Chipmunk prototype testing. This system will be used to look at multiple internal signals to determine the source of the output disruptions encountered when performing the temperature cycling test (48 hr. temperature cycling test from +50 to 22 deg. C). During a 32 hour period approximately 8 “glitches” were recorded where the output pulses stopped for periods of 20 seconds or so. There appears to be at least two phenomena going on. One type of problem is an apparent drift, possibly due to thermal stress in the input integrating capacitor. (See upper chart below.) A second problem is seen in the lower chart, which shows two reset pulses before the integrator gets to -0.5. Additional sensors, counters, and a transient recorder will be added to the test setup next week, to improve time resolution.





## Installation

### Accelerator Physics

Accounts have been obtained on the ORNL supercomputer for simulations of collective effects. Parallel ORBIT is being set up on this platform. Meanwhile the new parallel cluster has arrived and is being set up.

S. Danilov is extending the capabilities of ORBIT to include wideband feedback. This tool will allow us to evaluate requirements for a feedback system to damp collective instabilities.

S. Kim and M. Doleans are preparing Lorentz-force detuning analysis for Jlab prototype cryomodule data. They are trying to understand the dominant mechanical modes that play a role.

AP Area managers are working with Operations to flesh out the integrated testing plan programs prior to commissioning the hardware with beam.

Applications software group gave a demo of commissioning applications and a general scripting tool. The group is preparing software needed for MEBT commissioning in the fall.

### Operations Group

Plan of Action Submitted to DOE Sending internal milestones to Project Office.

Preparing Commissioning Program Plan, closeout for the FSAD.

Approaching the ASRC Committee about a transition to the ARR committee for the Front End-DTL ARR.

Met with CF on testing and operation of utilities.

### Ion Source Group

Paul Gibson, Robert Morton, and Syd Murray continue to participate in the installation of the front end.

All parts for the inductive matching network have been received. Installation will be completed next week.

The RF-amplifier incident also damaged the installed directional coupler, which had to be replaced.

A replacement inductor was received and installed in the QEI RF-amplifier. The amplifier is back in operation.

Robert Welton and Sonali Shukla continue to map the ion source plasma with 2 MHz RF fed through the capacitive matcher until the inductive matcher is ready for installation. Operations included up to 45 kW RF power.

Our development of a self-consistent, unbiased, elliptical-exclusion analysis of emittance data was presented in the Tuesday physics videoconference. To the best of our knowledge this is the first method to provide unbiased estimates of the emittance values as well as the associated uncertainties.

### **RF Group**

The linac RF group is busy preparing to position transmitters in the gallery 16-July-02. All equipment will be moved to the site a day or 2 before, the following week interconnecting the various parts takes place with checkout to follow.

We are getting up to speed for our new task of designing and installing the reference line.

Received first High Voltage Converter Modulator Equipment Control Rack from Ztec, Inc. Received cabling for 3 HVCM systems (control rack cables only). Identified several cables non-conforming to SNS Cable Design Criteria and worked with LANL and vendors to cost remanufacturing of cables. Initiated circuit modeling of HVCM system. Arranged for ORNL technician participation in Dynapower HVCM assembly workweek of July 15th.

### **Mechanical Group**

The slug tuners and post couplers machined to the final dimensions were received and installed in DTL-3. Tuning confirmation was performed by a joint LANL - ORNL team and was completed on Thursday afternoon. Field distribution and tilt sensitivity have been preserved with very small differences from the original values. The unloaded Q factor was measured at 41500 that is close to the computed value.

### **Magnet Systems**

Measurements were completed on the 8D406 HEBT Dipole.

The #5 8D533 Dipole was received and is on the measurement stand.

A measurement coil was received from Los Alamos for use with DTL Dipoles and Quads. We are setting this coil up in the CCL measurement stand.

We also replaced the water in the "DI" system with fresh DI water as there is no polishing loop on this system. The water became too conductive. So we had to stop measurements, and drain the system and replenish the water.

### **Vacuum Task**

Identification of potential design improvements to the mechanical drift tube (DT) support and alignment system continued and in particular a differential screw and collar scheme for vertical adjustment was developed.

Following alignment the MEBT has been mated to the RFQ and all vacuum bellows installed. The MEBT roughing valves and spool pieces and ion pumps have been installed, and re-assembly of the eight RFQ windows and ion pumps are targeted for completion and to be under vacuum by the end of the week. This installation was delayed by lack of O-ring spares needed for the window assembly. The LEBT high vacuum gate valves, together with the MEBT forelines showed traces of particulate contamination and these have been shipped to RATS for cleaning.

The post couplers were installed on DTL tank 3, prior to completion of leak testing at the vendors, a base pressure of only 5 Torr was achieved which precluded leak testing at a reasonable level of sensitivity. The post couplers will now be removed and returned to the vendor for leak testing.

First article acceptance of the RGA continued.

Source inspection of the three RGA pump carts being fabricated by PTB Sales was successfully completed. These units are now being prepared for shipping to ORNL.



RGA training was undertaken at SRS. This training is needed to allow effective integration of this RGA system to the pump carts being fabricated by PTB Sales.

The test chamber to allow vacuum leak testing of individually DT's with pressurized helium was received. Components for the seal test rig were received and a trail assembly identified components that needed to be reworked. Assembly of the rig and seal testing is planned to commence next week.

Accelerator equipment received this week included 8 ion pumps for the DTL/ CCL installation.

### **Cryogenics Group**

The tube steel for the siding is being installed on the north and south walls of the CHL/RF building. The roof sheeting is installed on all the CHL and RF sections of the building. Switchgear, conduit, cable trays and sprinklers are being installed in the CHL. The crane is being assembled in the warm compressor room. We anticipate the 4K cold box delivery the week of 8/12/02.

In the tunnel the pull head for the return line has been removed and the pipe caps for the 2 1/2 and 6 inch warm gas piping have also been removed. We have ordered the tooling to remove the supply pull head starting next week.

The anchor boxes are complete on the S-HB6/7 and S-HB8/9 modules. Work on the expansion boxes for these lines is 75% completed. Assembly of return module R-HB5/HB4 is 25% completed.

### **Electrical Systems Group**

Electrical tray installation in the DTL section of the klystron building and DTL section of the tunnel (DTL section available to ASD, i.e. up to DTL3 tank) has been completed during this week to the extend that cable pulls can start next week. SROs have been written to start cable and rack base installation next week. Pictures of tray installation are below.







**Survey and Alignment Group**

**Beam Diagnostics**